PROGRAM facts

U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

Innovations for Existing Plants

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PHASE II FIELD TESTING OF ADVANCED MERCURY CONTROL TECHNOLOGY

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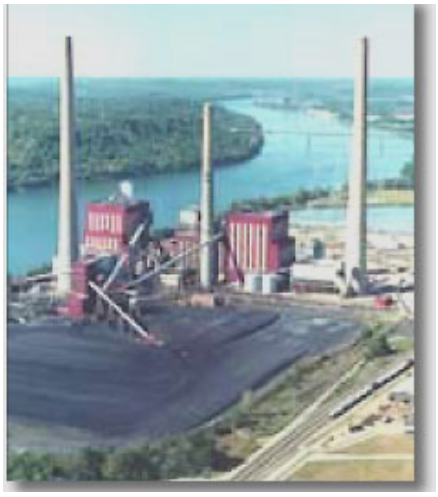
Background

The United States Environmental Protection Agency (EPA) has determined that regulation of mercury emissions from coal-fired utilities is necessary. Currently, EPA is in the process of developing mercury regulations for new and existing coal-fired electric generating units. In parallel, several proposed legislative measures have been introduced in recent sessions of Congress to control mercury along with sulfur dioxide and nitrogen oxides.



To help ensure that the existing fleet of coal-fired power plants can meet future regulatory requirements, the U.S. Department of Energy's National Energy Technology Laboratory (DOE/NETL) has been carrying out a research and development (R&D) program focused on the control of mercury emissions from coal-based power systems. Working collaboratively with power plant operators, the Electric Power Research Institute (EPRI), academia, state and local agencies, and EPA since 1990, the program has greatly advanced our understanding of the formation, distribution, and capture of mercury from electric-utility boilers. Continued R&D is necessary in order to bring advanced mercury control technology to the point that it is ready for commercial demonstration.

Mercury Research

The mercury control technology research activities are part of NETL's Innovations for Existing Plants (IEP) Program. The IEP Program seeks to create technology options that will enable the current fleet of coal-fired power plants to cost-effectively comply with future environmental regulations. The mercury component of the program is directed at the development of a broad suite of low-cost control options to respond to future regulatory decisions.

The near-term goal is to develop mercury control technologies that can achieve 50 to 70% mercury capture at costs ranging from $30,000 to $45,000 per pound of mercury removed or less. These technologies would be available for commercial demonstration by 2005 for bituminous plants and 2007 for lignite and subbituminous coal plants. The longer-term goal is to develop advanced mercury control technologies to achieve 90% or greater capture and would be available for commercial demonstration by 2010.

In support of the near-term goal, DOE/NETL selected eight new projects in September 2003 to test and evaluate mercury control technologies at coal-fired power plants under a recent Phase II mercury control technology solicitation. Building on promising advances that resulted from Phase I activities, these projects will focus on longer-term, large-scale field testing on a broad range of coal-rank and air pollution control device configurations (See Table 1). These tests will provide important information on mercury removal effectiveness, cost, and the potential impacts on plant operations including by-product characteristics. A second round of proposals will be due by the end of April 2004. DOE/NETL intends for the second round to focus on technologies for power plants that burn Powder River Basin coal, Texas lignite, or coal blends. The following provides a brief summary of each of the eight projects selected in the first round.

Phase II Mercury Control Project Summaries

Evaluation of Sorbent Injection for Mercury Control - ADA Environmental Solutions, LLC (ADA-ES), Littleton, Colorado, will evaluate injection of activated carbon and other sorbents to remove mercury for a variety of coal and air pollution control equipment configurations. Testing will be conducted at four power plants: (1) Sunflower Electric's Holcomb Station that burns a blend of subbituminous Powder River Basin (PRB) and bituminous coal; (2) Ontario Power's Nanticoke Station that burns a blend of PRB and bituminous coal; AmerenUE's Meramec Station that burns PRB coal; and (4) American Electric Power's (AEP) Conesville Station that burns bituminous coal. The research team also includes Alstom Power, EPRI, Western Fuels Association, and Norit Americas.

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Table 1 - DOE/NETL Phase II Mercury Control Projects

Project Title	Lead Company	Test Schedule*	Host Utility	Test Location	Coal Rank	PM	FGD
Evaluation of Sorbent Injection for Mercury Control	ADA-ES	3/04 - 6/04	Sunflower Electric	Holcomb	PRB/Bit. Blend	FF	SDA
		8/05 - 11/05	Ontario Power	Nanticoke	PRB/Bit. Blend	ESP	---
		8/04 - 11/04	AmerenUE	Meramec	PRB	ESP	---
		3/05 - 6/05	AEP	Conesville	Bit.	ESP	Wet FGD
Amended Silicates for Mercury Control	Amended Silicates	9/04 - 10/04	Cinergy	Miami Fort 6	Bit.	ESP	---
Sorbent Injection for Small ESP Mercury Control	URS Group	3/04 & 9/04 - 10/04	Southern	Yates 1	Bit.	ESP	Wet FGD
			Southern	Yates 2	Bit.	ESP w/ NH_3/SO_3	---
Pilot Testing of Mercury Oxidation Catalysts for Upstream of Wet FGD Systems	URS Group	6/04 - 7/05	TXU	Monticello 3	TX Lignite	ESP	Wet FGD
		2/05 - 3/06	Duke	Marshall	Bit.	ESP	---
Evaluation of MerCAP for Power Plant Mercury Control	URS Group	7/04 - 1/05	Great River Energy	Stanton 10	ND Lignite	FF	SDA
		1/05 - 8/05	Southern	Yates 1	Bit.	ESP	Wet FGD
Enhancing Carbon Reactivity in Mercury Control in Lignite-Fired Systems	UNDEERC	4/04 - 6/04	Basin Electric	Leland Olds 1	ND Lignite	ESP	---
		9/04 - 10/04	Great River Energy	Stanton 10	ND Lignite	FF	SDA
		4/05 - 6/05	Basin Electric	Antelope Valley 1	ND Lignite	FF	SDA
		4/04 - 5/04	Great River Energy	Stanton 1	ND Lignite	ESP	---
Mercury Oxidation Upstream of an ESP and Wet FGD	UNDEERC	6/05 - 8/05	Minnkota Power	Milton R. Young 2	ND Lignite	ESP	Wet FGD
		8/05 - 9/05	TXU	Monticello 3	TX Lignite	ESP	Wet FGD
Advanced Utility Mercury-Sorbent Field-Testing Program	Sorbent Technolgies	1/05 - 4/05	Duke	Buck	Bit.	Hot ESP	---
		6/04 - 9/04	Detroit Edison	St. Clair	Bit./PRB blend	ESP	---

* Test schedules are subject to change based on host-site availability.

Amended Silicates for Mercury Control - Amended Silicates, LLC (a joint venture of ADA Technologies, Inc. and CH2M Hill), Littleton, CO, will test a new non-carbon sorbent, Amended Silicates™, which could provide cost effective mercury capture while avoiding potential adverse impacts on fly ash sales. Testing will be conducted at Cinergy's 175 MW Miami Fort Unit 6 that burns bituminous coal. The research team also includes the University of North Dakota Energy and Environmental Research Center, Western Kentucky University, and Boral Materials Technologies.

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Sorbent Injection for Small ESP Mercury Control - URS Group, Inc. (URS), Austin, Texas, will test sorbent injection technology upstream of a small collection area ESP. Previous full-scale sorbent injection tests have involved relatively large ESPs, but more than 60 percent of the industry is equipped with ESPs having small size collection areas. Testing will be conducted at Southern Company's Plant Yates Unit 1 & 2 that burn bituminous coal. Other team members include ADA-ES and EPRI.

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Pilot Testing of Mercury Oxidation Catalysts for Upstream of Wet FGD Systems - URS will conduct pilot-scale testing of fixed-bed catalysts to oxidize elemental mercury in order to increase overall mercury capture in downstream wet FGD systems. Four catalyst materials are scheduled to be tested including: palladium, titanium/vanadium, gold, and carbon. Testing will be conducted at two plants: (1) TXU's Monticello Station Unit 3 that burns Texas lignite; and (2) Duke Energy's Marshall Station that burns low-sulfur bituminous coal. The research team also includes EPRI, Great River Energy, and City Public Service of San Antonio.

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Evaluation of MerCAP for Power Plant Mercury Control - URS will test EPRI's Mercury Control via Adsorption Process (MerCAP™) technology. The process involves placing a regenerable, fixed-structure gold sorbent into the flue gas stream to capture mercury. Testing will be conducted at Great River Energy's lignite-fired Stanton Station and at Southern Company's bituminous-fired Plant Yates. At Stanton Unit 10, MerCAP sorbent structures will be retrofitted into a single compartment of the fabric filter baghouse equivalent to a 6 MW application. At Plant Yates Unit 1, MerCAP sorbent structures will be configured as a mist eliminator located downstream of a 1 MW pilot-scale wet FGD absorber. The research team also includes Apogee Scientific, EPRI, ADA-ES, and North Dakota Industrial Commission (NDIC).

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Mercury and Coal By-Products

Because mercury is highly volatile, nearly all of the mercury in coal vaporizes in the boiler and exits in the flue gas. Existing air pollution control devices can provide some degree of mercury control and captured mercury may reside at trace levels in combustion by-products such as fly ash and FGD material. While the use of sorbent and oxidation technologies for mercury control can reduce stack mercury emissions, more mercury may partition to the solid by-products.

Coal-fired power plants generate large volumes of solid by-products, which can present significant disposal issues. The American Coal Ash Association estimates that the electric utility industry generated more than 117 million tons of by-products in 2001. In addition, future SO_2 regulations may result in even greater quantities of by-products being generated due to the installation of wet scrubbers.

While almost one-third of the total amount of by-products presently generated is beneficially reused, the remaining two-thirds are disposed of in landfills or surface impoundments. The regulation and subsequent control of mercury emissions from coal-fired power plants could lead to additional scrutiny of current by-product re-use activities and long-term management practices.

In recognition of the potential impact of mercury regulations on by-product use and disposal, DOE/NETL will evaluate the leaching and volatilization of mercury from the Phase II field testing by-products.

PARTNERS

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Boral Materials Technologies

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EPRI

Fuel Tech

Lignite Consortium

Norit Americas

North Dakota Industrial Commission

PS Analytical

Sorbent Technologies

Spectra Gases

Stock Equipment

UNDEERC

URS Group

Western Fuels Association

Western Kentucky University

Enhancing Carbon Reactivity in Mercury Control in Lignite-Fired Systems - University of North Dakota Energy and Environmental Research Center (UNDEERC), Grand Forks, North Dakota, will test enhancements to activated carbon sorbent injection to increase mercury capture for plants burning low-rank lignite coals. Lignite produces higher levels of elemental mercury, which is more difficult to remove. Two different technology approaches will be evaluated: (1) injection of chlorine-based additives in conjunction with activated carbon sorbents, and (2) injection of chemically treated activated carbon sorbents. The first approach will be tested at Basin Electric's 210 MW Leland Olds Station Unit 1 and the 440 MW Antelope Valley Station Unit 1. The second approach will be tested at Great River Energy's 140 MW Stanton Station Unit 1 and the 60 MW Stanton Station Unit 10. The research team also includes URS, ADA-ES, Babcock & Wilcox (B&W), EPRI, NDIC, and the Lignite Consortium.

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Mercury Oxidation Upstream of an ESP and Wet FGD - UNDEERC will test the effectiveness of using chlorine-based additives without supplemental sorbent injection to increase mercury oxidation and therefore enhance mercury capture at lignite-fired plants equipped with an ESP and wet FGD. Testing will be conducted at Minnkota Power Cooperative's Milton R. Young Unit 2 that burns North Dakota lignite and TXU's Monticello Unit 3 that burns Texas lignite. The research team also includes URS, ADA-ES, B&W, EPRI, NDIC, and the Lignite Consortium.

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Advanced Utility Mercury Sorbent Field-Testing Program - Sorbent Technologies Corporation, Twinsburg, Ohio, will test an advanced halogenated activated carbon sorbent that can be used as a cost-effective alternative to commercial activated carbon injection for mercury capture. A short-term trial of the halogenated sorbent was conducted at Duke Energy's Cliffside Plant that is equipped with a hot-side ESP. Longer-term testing will be conducted at Duke Energy's 140 MW Buck Plant that burns low-sulfur bituminous coal and at Detroit Edison's 80 MW St. Clair Station that burns a blend of PRB and bituminous coal. Other team members include Fuel Tech, Western Kentucky University's Combustion Laboratory, PS Analytical, Spectra Gases, and Stock Equipment Company.

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